Hydraulic processes in the south Delta are influenced by tides, river inflow, weather, channel diversions, temporary rock barriers in Middle River, Old River at Tracy, head of Old River, Grantline Canal, and water releases from upstream reservoirs. Unimpeded tidal action into tidal wetlands affects sediment and nutrient supplies. These supplies influence the natural marsh successional processes. Outflows from tidal wetlands transport nutrients and carbon into aquatic habitats of the Bay-Delta.

Hydraulic processes have been modified in the south Delta since the 1800s. Further reduction in flow started in the 1930s with the completion of the Hetch Hetchy Aqueduct from the Tuolumne River. In the early 1940s, construction of Friant Dam began to alter hydraulic patterns significantly, particularly during drier water years. The South Bay Aqueduct began diversions directly from the South Delta Ecological Management Unit starting in 1962. Hydraulic patterns were further modified by the significant export pumping near Tracy, which began in 1951 for the CVP and in 1968 near Byron for the SWP.

South Delta Ecological Management Unit Habitat Acreage

Habitat	*Acres*
Riparian scrub	*899*
Riparian woodland	*263*
Fresh emergent wetland (marsh)	*650*
Seasonal wetland	*430*
Total	*2,242*

Current hydraulic conditions in the south Delta are unhealthy and affect the ability of this Ecological Management Unit to support channels with suitable residence times and more natural net flows; to provide adequate transport flows to the entrapment zone; and to support high-quality rearing and spawning habitat, nutrient cycling, and foodweb integrity.

While the effects of many small unscreened diversions in the south Delta are undocumented, effects of the two large export facilities on nearly all Delta anadromous and resident fishes have been well described and are very significant (See Water Diversions Vision in Volume I: Ecological Attributes of the San Francisco Bay-Delta Watershed.)

South Delta Ecological Management Unit Land Use

Land Use	*Acres*
Nonflooded Ag	*98,269*
Flooded Ag	*1,909*
Orchard	*3,668*
Vines	*3,466*
Total cultivated	*107,312*
Grass	*40,483*
Other	*29,434*
Total	*177,229*

CENTRAL AND WEST DELTA ECOLOGICAL MANAGEMENT UNIT

The Central and West Delta Ecological Management Unit is bounded on the west and north by Suisun Bay, the Sacramento River, Highway 12, the South Fork of the Mokelumne River, and White and Disappointment Sloughs; and on the south by the San Joaquin River, Turner Cut, Whiskey Slough, Trapper Slough, Victoria Canal, and Italian Slough. Notable features are the San Joaquin and Sacramento rivers, Frank's Tract, the channel islands in Middle and Old rivers, and Potato and Disappointment Sloughs. Land elevations generally range from 10 feet below to as deep as 21 feet below mean sea level. This Ecological Management Unit consists of more than 200,000 acres. It contains most of the mainstem of the San Joaquin River in the Delta. Agricultural uses account for 48% of the area and include field crops, orchards, and vineyards. Approximately 3% of the area consists of riparian, oak woodland, fresh emergent wetland, and seasonal wetland. Much of the riparian and wetland habitat is found on the extensive network of small channel islands in Old and Middle rivers; on White, Potato, and Disappointment Sloughs; along the edges of Big Break and Frank's Track; on the Lower Sherman Island Wildlife Area; and on adjacent tide lands on

both sides of the Sacramento River channel between Collinsville and Rio Vista, including Decker Island and adjacent channels. (See the table in this section for habitat acreage.)

The central and west Delta contains most of the heavily subsided (sunken) islands in the Delta. Although nearly 98% of this unit was not reclaimed until after 1900, the highly organic soils of this unit have oxidized at an accelerated rate. This has resulted in subsidence (sinking) of 20 to 30 feet in many places. The subsidence has led to serious potential erosion of the levees around the islands and numerous levee breaks in the last several decades.

Central and West Delta Ecological Management Unit Habitat Acreage

Habitat	*Acres*
Riparian scrub	*1,004*
Riparian Woodland	*248*
Fresh emergent wetland	*5,040*
Seasonal wetland	*544*
Total	*6,836*

The central and west Delta has some of the highest levels of wintering waterfowl within the Delta. They use seasonally flooded croplands on the deeper islands in this unit. The California Department of Water Resources is one of the most significant landowners in this unit owning most of Twitchell and Sherman islands.

Hydraulic processes in the central and west Delta are influenced by tides, river inflow, weather, channel configuration, water diversions, and river inflow. Unimpeded tidal action into tidal wetlands affects sediment and nutrient supplies into those wetlands to complement natural marsh successional processes. Tidal action associated with flows out of tidal wetlands transport nutrients and organic carbon into aquatic habitats of the Bay-Delta.

Hydraulic processes have been modified in the central and west Delta since the 1800s. The South Bay Aqueduct began diversions directly from the south Delta starting in 1962. Deliveries to the Contra Costa Canal began in 1962 directly from Rock Slough in the western portion of this unit. Hydraulic patterns were further modified by the significant export pumping, which began in 1951 for the CVP and in 1968 for the SWP.

Current hydraulic conditions in the central and west Delta are unhealthy. The ability of this Ecological Management Unit to maintain suitable residence times and provide more natural flows are restricted. These restrictions inhibit adequate transport flows to the entrapment zone and reduce high-quality rearing and spawning habitat, nutrient cycling, and foodweb integrity.

In addition to many small unscreened agricultural diversions (e.g., siphons and pumps), electric generating stations divert up to 1,500 cfs of Delta water. The water is diverted at Antioch, along the San Joaquin River channel, for cooling purposes. Some juvenile Delta fish are stressed or killed in the water diverted for plant cooling. Though the amount of heat added to the Delta is small, it is locally measurable. This combined with other heated discharges contributes to significant seasonal warming of Delta waters.

VISION FOR THE ECOLOGICAL MANAGEMENT ZONE

The vision for the Sacramento-San Joaquin Delta Ecological Management Zone is to achieve a healthier system that better provides for the ecological needs of plants and animals using the system. A healthy ecosystem will have more natural freshwater flow and channel hydraulic patterns. A more natural channel configuration with greater amounts of slough and permanent and seasonal wetland habitats will provide more habitat for fish, waterfowl, and wildlife, and improve aquatic foodweb production and water quality. Improvements in riparian vegetation along waterways will reduce heating of the water and provide habitat for fish and wildlife. A healthy Delta ecosystem will lead to improved survival of anadromous fish that depend on the Delta for a portion of their life cycles, including chinook salmon and steelhead, striped bass, white and green sturgeon, and American shad. A healthy Delta will also help toward improving the native resident fish community including delta smelt and splittail, as well as resident

wildlife, migratory waterfowl, neotropical birds, and special-status plants and plant communities.

A restored Delta ecosystem will have improved ecological processes and habitats and reduced stressors. Ecological processes that will be improved include freshwater inflow and outflow, Delta hydraulics, channel configuration, water temperature, floodplain processes, and aquatic and terrestrial foodweb productivity. There will be substantial increases in the acreage of tidal emergent wetlands, seasonal and permanent nontidal wetlands, and shallow water, riparian, and tidal slough habitats. Stresses from land use, urban and industrial development, contaminants, land reclamation, water diversions, flood control (i.e., levees and bank protection), non-native plant and animal species, recreational activity (e.g., boating), water conveyance structures, livestock grazing, and agricultural practices will be reduced.

Following restoration, the Delta will be a better fish spawning, rearing, and migration habitats. A healthy Delta will be more effective in nutrient cycling and will increase primary (plant) and secondary (animal) productivity. Productivity will increase through improved freshwater inflow and outflow, longer hydraulic residence time in Delta channels, and an increase in the amount of tidal wetlands. Improved Delta productivity will also improve the productivity of northern San Francisco Bay.

Both the endangered winter-run chinook salmon and the threatened delta smelt will benefit from improved Delta inflow and outflow during the late winter and spring, greater estuary (river mouth) foodweb productivity, riparian and wetland habitat improvements, and improved screening systems at water diversions.

Much of the new fish and wildlife habitats will come from agricultural lands that are either no longer productive or too expensive to maintain (e.g., levee maintenance costs are too high). These lands will be purchased from willing sellers. Productive agricultural lands will continue to be an integral part of the Delta habitat mosaic and will be protected by upgrading channel configurations and levees.

The Delta's levee system will be effectively maintained to reduce the risk of failure. This will also minimize loss of water quality (e.g., saltwater intrusion) and loss of high-value wildlife habitat and agricultural land. Riparian, wetland, and aquatic habitats along the levees will be improved where possible. In those areas where leveed lands can eventually be restored to tidal action, the exterior levees will be maintained until the island interiors are restored to the proper elevations necessary to support the desired habitats.

A basic restoration strategy is to protect and enlarge areas of remaining native habitats and establish the connectivity of these areas. For example, the Cosumnes River Preserve (Badger Creek Marsh) supports a sizable population of giant garter snake. Caldoni Marsh (White Slough Wildlife Area) west of Lodi is also an area of several recent and historical giant garter snake sightings. Stone Lakes Refuge-Morrision Creek drainage and the Yolo Basin also contain suitable garter snake habitat, though population sizes are thought to be quite small. Restoring connectivity of these areas would benefit giant garter snakes and contribute to their recovery by providing corridors for the reestablishment of historic population. Such areas in the Delta include:

- the Cache Slough complex,
- Stone Lakes,
- the Cosumnes River Preserve in the north Delta, and
- the Sherman Island Wildlife Area in the western Delta.

Benefits to species and habitats will come predominantly through changes to important physical processes. These processes include:

- freshwater flow into and through the Delta
- hydraulic conditions within Delta channels, and
- the channel configuration of the Delta.

Increasing the amount of the floodplain that is inundated by flood waters and tides, and increasing the amount of shallow water and shorelines will increase tidal aquatic, wetland, and riparian habitats. Habitat improvements will be made in concert with floodplain and levee improvements. Levees will be rebuilt and maintained to include shallow water and riparian habitats that not only protect the integrity of the levees, but also provide valuable fish and wildlife habitats. Agricultural lands on Delta islands will be managed to support waterfowl and wildlife better. Tidal sloughs and creeks will be restored to their former health from improved channel hydraulics,

water quality, and riparian vegetation, and reductions in non-native aquatic plants (e.g., water hyacinth).

To ensure this recovery, it will be necessary to reduce stressors. Examples of stressors include the alteration of Delta hydraulic patterns by pumping in the South Delta, unscreened or poorly screened diversions, non-native invasive plant species (e.g., water hyacinth), toxic substances, and human disturbance such as erosion of sensitive habitats from boat wakes. In some cases, fish and wildlife may need temporary or even long-term support through artificial habitat construction, reductions in legal and illegal harvest, or artificial reproduction (e.g., hatcheries).

Improvements to restore the health of the estuary need to be made in a way that contribute to the quality of life for Delta fish and wildlife populations, while protecting the region's agricultural economy and preserving landowner property rights. Rebuilt levees will protect valuable agricultural lands and other properties. Improved fish and wildlife populations will benefit recreation. Greater areas of wetlands and riparian habitats will benefit water quality. With restoration, the Delta would provide improved educational and recreational opportunities. The Delta will provide increased public opportunities for wildlife observation, photography, nature study and wildlife interpretation, fishing, hunting, picnicking, and other activities in a manner that is consistent with maintaining the fish and wildlife values of the Delta and protecting adjacent private properties.

Attaining this vision requires extensive efforts in the Delta, and in watersheds above the Delta. For this reason, this Delta vision is closely tied to the visions for the other 13 Ecological Management Zones. Important ecological processes such as streamflow are controlled by upstream reservoirs and watersheds to the Delta. Delta habitat and the productivity of that habitat are greatly dependent on physical, chemical, and biological processes upstream of the Delta.

A focus on natural processes may reduce the need for measures that artificially maintain habitat and plant and animal populations (e.g., hatcheries). It may be necessary, however, to artificially sustain habitats, severely inhibit stressors, and increase population abundance until such time when natural ecological processes and functions are restored. This will be particularly true during the recovery period.

INTEGRATION OF ACTIONS FOR STAGE 1 IMPLEMENTATION

Stage 1 actions are those actions to be implemented during the first 7 years of the program. The selection of Stage 1 actions is guided by the Strategic Plan for Ecosystem Restoration (2000). The Strategic Plan identifies 12 important issues related to substantial uncertainties about Bay-Delta ecosystem dynamics that should be addressed by adaptive management and adaptive probing early in Stage 1. Many of the issues address the uncertainty resulting from incomplete information and unverified conceptual models, sampling variability, and highly variable system dynamics.

Relevant issues in the Sacramento-San Joaquin Delta Ecological Management Zone that need resolution during Stage 1 include:

- The impact of introduced species and the degree to which they may pose a significant threat to reaching restoration objectives.
- Recognition that channel dynamics, sediment transport, and riparian vegetation are important elements in a successful restoration program and the need to identify which parts of the system can be restored to provide the desired benefits.
- Development of an alternative approach to manage floods by allowing rivers access to more of their natural floodplains and integrating ecosystem restoration activities with the Army Corps of Engineers' Comprehensive Study of Central Valley flood management programs.
- Increasing the ecological benefits from existing flood bypasses, such as the Yolo Bypass, so that they provide improved habitat for waterfowl, fish spawning and rearing, and possibly as a source of food and nutrients for the estuarine foodwebs.
- Thoroughly testing the assumptions that shallow water tidal and freshwater marsh habitats are limiting the fish and wildlife populations of interest in the Delta.
- A better understanding of the underlying mechanisms of the X2 salinity standard in the Delta and the resultant effects on aquatic organisms.

- A need to better understand the linkage between the decline at the base of the estuarine foodweb and the accompanying decline of some, but not all, species and trophic groups.
- Clarifying the extent to which entrainment at the CVP and SWP pumping plants affects the population size of species and invertebrates.
- Clarifying the suitability and use of the Delta for rearing by juvenile salmon and steelhead.

The proposed Stage 1 approach for the Sacramento-San Joaquin Delta Ecological Management Zone is to broadly design and implement actions that will make a substantial contribution to developing aquatic and terrestrial habitat corridors through the Delta which connect with upstream areas. In addition to the focus on the corridor concept, a variety of general actions will be implemented. Implementation of these actions and linking their implementation with adaptive management through the Comprehensive Monitoring, Research and Monitoring Program will be major steps toward resolving the important Stage 1 issues and will set the direction for subsequent implementation stages.

The three major habitat corridors envisioned include the following:

- **THE NORTH DELTA HABITAT CORRIDOR** will provide a large, contiguous habitat corridor connecting the mosaic of tidal marsh, seasonal floodplain, riparian and perennial grassland habitats in the Yolo Bypass, Cache Slough Complex, Jepson Prairie Preserve, Prospect Island, Little Holland Tract, Liberty Island, and Steamboat Slough.
- **THE EAST DELTA HABITAT CORRIDOR** will restore a large, contiguous corridor containing a mosaic of habitat types including tidal perennial aquatic, riparian and riverine aquatic habitat, freshwater fish habitat, essential fish habitat, and improved floodplain-stream channel interactions along the Cosumnes River. The focus area includes the South Fork Mokelumne River, East Delta dead-end sloughs, Georgiana Slough, Snodgrass Slough, and the Cosumnes River.
- **THE SAN JOAQUIN RIVER HABITAT CORRIDOR** will provide a contiguous habitat corridor of tidal perennial aquatic habitats, riparian and riverine aquatic habitat, freshwater fish habitat, essential fish habitat, and improve river-floodplain interactions.

In addition to the three habitat corridors, many other restoration actions are proposed for implementation during Stage 1. These additional actions range from conversion of Frank's Tract to shallow water habitats to developing a ballast water management program to halt the accidental introductions of invasive aquatic organisms.

VISIONS FOR ECOLOGICAL MANAGEMENT UNITS

NORTH DELTA ECOLOGICAL MANAGEMENT UNIT

Habitat restoration, fish passage improvement, and floodplain modifications are the primary focus of the restoration program in the North Delta Ecological Management Unit Restoring a mosaic of tidal emergent wetland and SRA habitat at the ecological-unit level should provide essential resources for all species, particularly communities or assemblages of species that have declined significantly within the Delta.

Habitat restoration will focus on four areas:

- the Yolo Bypass including shallow agricultural islands at the south end of the bypass (i.e., Prospect, Little Holland, and Liberty)
- tidal sloughs between the Sacramento Ship Channel and the Sacramento River (i.e., Steamboat, Miner, Oxford, and Elk)
- the Stone Lakes-Cosumnes Preserve complex, and
- the main channel of the Sacramento River from Sacramento to Rio Vista.

Seasonal patterns of freshwater inflow from the Sacramento River, Yolo basin (Cache and Putah creeks), and the Cosumnes and Mokelumne rivers would be improved. Fish passage problems in the Yolo Bypass, DCC, Sacramento Ship Channel, and Snodgrass Slough should be resolved. Unscreened diversions in important habitat and migration pathways should be screened. Non-native plants will be controlled.

The vision for the North Delta Ecological Management Unit focuses heavily on habitat restoration in the major subunits and the creation of a North Delta habitat corridor. In the Yolo Bypass, channels should be constructed to connect to channel improvements in the Yolo basin (i.e., connections with Putah and Cache creeks, the Colusa drain, and the Sacramento River through the Sacramento and Fremont weirs). These channels should be constructed as permanent sloughs along either side of the bypass.

The sloughs will feed permanent tidal wetlands constructed along the bypass and connected with existing wetlands within the Yolo Basin Wildlife Area. The sloughs would provide rearing and migrating habitat for juvenile and adult salmon, and other native fishes. The sloughs would drain into extensive marsh-slough complexes developed in shallow islands (i.e., Liberty, Little Holland, and Prospect) at the lower end of the bypass. These changes, in conjunction with structural improvements to the bypass floodway (e.g., reducing the hydraulic impedance of the railroad causeway paralleling Interstate 80, and removing levees along the lower Sacramento Ship Channel (see below), will retain and possibly increase the flood bearing capacity of the Yolo Bypass.

To the east of the Yolo Bypass, the vision includes some improvements to the Sacramento Ship Channel. Fish passage problems at the gate structure on the Sacramento River at the north end of the ship channel should be resolved by constructing fish passage facilities. Connections between the ship channel and the new island complexes at Liberty, Little Holland, and Prospect Islands would be considered.

The major sloughs to the east between the ship channel and the Sacramento River, including Miner, Steamboat, Oxford, and Elk, should be improved as salmon migration corridors. A riparian habitat would be improved along these sloughs. Setback levees along portions of these sloughs may expand the slough and adjacent marsh complexes. Increases in the hydraulic connections at the northern end of the slough complex on the Sacramento River and at the southern end at Prospect Island would increase tidal and net flows through the complex, which along with habitat improvements, could represent important rearing and migrating habitat improvements for salmon and other anadromous and resident fish.

Along the Sacramento River channel between Sacramento and Rio Vista, restoration is limited to improvements to riparian vegetation along the major federal levees and to protection and possible improvements to retain remaining shallow-water habitat and tule berms along the river sides of the levees. In addition, habitats would benefit from improving and maintain flows that contribute to riparian regeneration. These habitats may be important spawning habitat of delta smelt and other native Delta fishes and important rearing and migratory habitats of juvenile salmon and steelhead.

The vision for the Stone Lakes-Snodgrass Slough-Lower Cosumnes/Mokelumne complex at the northeast side of the North Delta Ecological Management Unit includes extensive habitat improvements. These improvements will be consistent with increasing the connection of wetlands and riparian woodlands in the Stone Lakes and Cosumnes preserves. Remnant marshes, riparian woodlands, and tidal sloughs along Snodgrass Slough would be protected and improved. Some small units of leveed agricultural lands would be converted to marsh-slough complexes. Flood control levees would be upgraded and riparian and shallow-water habitats improved on the waterside of the levees. Gated connections with appropriate fish passage facilities (and, potentially, screens) would be considered on the Sacramento River at the north end of Snodgrass Slough and Morrison Creek near Hood to provide this portion of the unit with water at a level consistent with pre-levee flows. Water hyacinth infestations would be controlled throughout the complex. All unscreened agricultural diversions located along salmon migratory corridors or spawning habitat of delta smelt would be screened.

Changes in the operation of the DCC gates would be considered depending on which program alternative is chosen.

EAST DELTA ECOLOGICAL MANAGEMENT UNIT

The vision for the East Delta Ecological Management Unit focuses on restoration of native Delta habitats that will improve spawning, rearing, and migration habitats of native Delta fishes, as well as provide

extensive new amounts of wetland, waterfowl, and wildlife habitat. Restoring a mosaic of habitat conditions at a landscape level should provide essential resources for all species, especially communities or assemblages of species that are rare within the Delta. Improvements along the south Mokelumne River and adjoining dead-end sloughs on the east edge of the Delta should be the focus of restoration efforts.

The vision for Georgiana Slough, Snodgrass Slough, the Cosumnes River and the South Ford of the Mokelumne River channel is to improve riparian and tidal marsh habitats and restore ecological processes, such as floodplain-river interactions, to the degree feasible to create a sustainable East Delta habitat corridor.

The vision for the east side of the unit along the South Mokelumne River and its adjoining dead-end sloughs (Beaver, Hog, and Sycamore) is extensive restoration of native Delta habitats. Levee setbacks and improvements along the river and sloughs would be accompanied by shallow-water and riparian habitat improvements.

Subsided leveed lands between the sloughs would be converted to floodplain overflow basins. These floodplains would support non-tidal, permanent tule-marsh wetlands, or seasonal agricultural production. After many decades of flooding, marsh growth, and sediment-laden flood overflow, these floodplains could be converted to tidal wetland.

Tidal headwaters of sloughs and adjacent lands would be opened to provide permanent tidal wetland marsh-slough complexes. Conversion of these agricultural lands would also reduce water diversions (i.e., loss of water and juvenile fish). Levee setbacks and a wider floodplain would improve habitat for fish including resident delta smelt and splittail and seasonal migrant salmon and steelhead from the Cosumnes and Mokelumne rivers.

SOUTH DELTA ECOLOGICAL MANAGEMENT UNIT

Large-scale habitat restoration, channel and floodplain improvements, hydraulics, and losses at unscreened diversions and water export facilities are the primary focus of the restoration program in the South Delta Ecological Management Unit. Restoring a mosaic of habitat conditions at a landscape level should provide essential resources for all species, particularly communities or assemblages of species that are rare within the Delta.

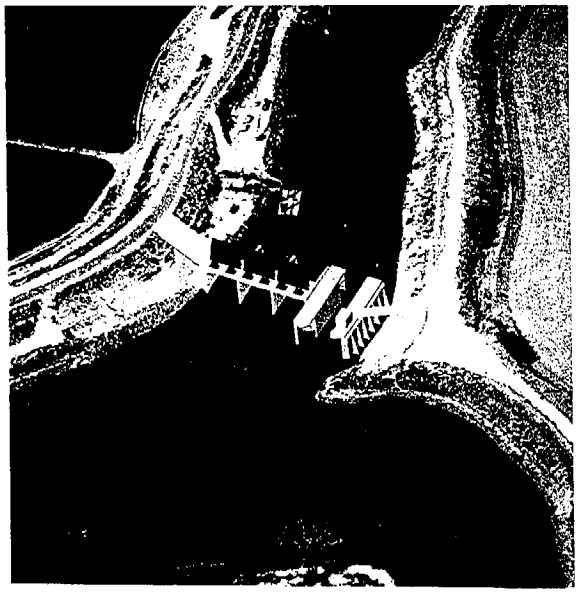
The vision for the South Delta Ecological Management Unit focuses on restoring floodplain habitat along the lower San Joaquin River between Mossdale and Stockton and improving riparian habitat along leveed sloughs throughout the unit. This is integral to the creation of the San Joaquin River habitat corridor. Improving interior slough complexes of the Old and Middle rivers would depend on which CALFED alternative is chosen for conveyance through the Delta. Minimal improvements would be made under alternatives that use existing Delta channels because these channels would remain major conduits for moving water to the export pumps. Other alternatives would provide more flexibility in the form of improvements in riparian and emergent wetland habitat and channel configurations. Depending on the preferred alternative, the South Delta Ecological Management Unit could be a location in which extensive restoration of tidal emergent wetlands and tidal perennial aquatic habitats occurs. This is influenced by the present land elevations and because land subsidence has been less dramatic that in other regions of the Delta.

A major focus of the vision in the south Delta will be expansion of the floodway in the lower San Joaquin River floodplain between Mossdale and Stockton. Setback levees and overflow basins offer opportunities to increase the flood-bearing capacity of the existing configuration of the river floodplain, as well as potential for creating significant amounts of native tidal emergent wetlands within the floodplain, regardless of which conveyance alternative is chosen.

Another important focus of the vision is to solve the problems associated with the export of water from the south Delta export facilities of the SWP and CVP near Byron and Tracy, respectively. Under all three CALFED alternatives, it is imperative that the loss of juvenile anadromous and resident fishes at the two export facilities be reduced as soon as possible. A new fish screen facility would be constructed that would screen all water for both facilities. The screen system would include a state-of-the-art fish collection, handling, and transport system that would reduce fish losses. Some alternatives would further reduce losses of fish from the south Delta by limiting

diversions from the south Delta in seasons when fish are most abundant or vulnerable. Fish losses could also be reduced by providing alternative sources of water to south Delta islands, which would otherwise divert water from existing channels.

A barrier at the head of Old River would be installed to prevent San Joaquin River water and fish from moving into the southern Delta. The barrier would help ensure that San Joaquin River water and juvenile salmon would have some chance of reaching the western Delta and the San Francisco Bay. Precautions would be taken in the operation of the barrier to not cause increased delta smelt, winter-run chinook salmon, and other fishes movement south into the South Delta and greater losses at south Delta export facilities.



Conceptual view of a fish barrier at the Head of Old River (DWR).

CENTRAL AND WEST DELTA ECOLOGICAL MANAGEMENT UNIT

Restoring habitat is the primary focus of the restoration program in the Central and West Delta Ecological Management Unit. Restoring a mosaic of tidal emergent wetland and SRA habitat on a large scale should provide essential resources for all species dependent on the Delta. Protecting and enhancing levees around all the deeper islands should include major adjacent shoal and shallow-water habitats, as well as riparian and tule-berm (midchannel islands) improvements. Changes in channel hydraulics will protect and improve habitats in specific sloughs. Water conveyance through the Delta should be concentrated in specific channels that should be reinforced for that purpose, and little habitat restoration should be conducted along these channels so as not to encourage residence of juvenile fishes. Portions of deeper islands should be reclaimed where possible for tidal or nontidal marsh habitat. Unscreened diversions in important migration pathways of salmon and delta smelt should be screened or relocated to other channels.

The vision for the Central and West Delta Ecological Management Unit is to restore fresh emergent wetland habitat, shoal and shallow-water aquatic habitat, and adjacent riparian habitat. Along the main channel of the San Joaquin River where levees are being upgraded; wetland, shoal, shallow-water, and adjacent riparian habitat should be improved. Where feasible, new construction should set back levees on portions of islands where the ratio of levee length to protected agricultural acreage is high. This will potentially reduce levee construction and maintenance costs and provide new tidal shallow-water, slough, wetland, and riparian habitat.

These selected islands would be on higher elevation lands to minimize the need for fill; however, some fill would be needed on deeper corners. This might be closely linked with the LTMS strategy for the beneficial reuse of dredge materials as it would accelerate marsh rebuilding processes. On such setbacks, levees would initially be maintained while fill was applied and habitats developed. Eventually, the levees would be breached or gated to allow tidal flows into the newly developed habitats. In some cases, entire small islands may be reclaimed, similar to the way in which portions of western Sherman Island in the west Delta were reclaimed for aquatic and marsh habitat. Along the margins of the unit selected levees could be breached or removed to provide areas of tidal wetlands and adjacent grasslands. The amount of new habitats potentially derived from these actions represents as much as 10% of the total acreage in the Central and West Delta Ecological Management Unit.

Selected tidal channels and sloughs in the Central and West Delta Ecological Management Unit (e.g., Potato Slough and Disappointment Slough) retain good habitats in the form of midchannel islands, shoreline marshes and riparian woodlands, and

shallow waters. These habitats would be protected and would also require active water hyacinth control.

On deeper Delta islands, levees should be upgraded to protect them from catastrophic failure. Portions of or all of some islands would be considered for establishing permanent nontidal wetlands. Approximately 30,000 acres of these islands would be appropriate for consideration of permanent or seasonal wetland development, or combination wildlife habitat and agricultural use. Selected islands may also be appropriate for flood overflow basins or seasonal water storage reservoirs.

Along the west side of the unit in the Highway 4 corridor, there are many opportunities to combine urban, agricultural, and native Delta habitat developments. There are many opportunities for tidal slough and marsh habitat development in this area.

Unscreened diversions along major pathways of salmon and delta smelt would be relocated or screened. Screening systems at Antioch electric power plants would be upgraded to reduce loss of fish to entrainment through or impingement on the fish screens. The extent of screening needs would depend on which program alternative is chosen

VISIONS FOR ECOLOGICAL PROCESSES

CENTRAL VALLEY STREAMFLOWS: Much of the fresh water of the State drains the watersheds of the Central Valley through the Delta. A healthy pattern of freshwater inflow into and through the Delta would entail natural late winter and spring flow events especially in dry and normal water-year types. Such flow events would support many ecological processes and functions essential to the health of important Bay-Delta fish populations. Inflow to the Delta is impaired in dry and normal rainfall years from the storage and diversion of natural inflow to the basin watersheds. The need for inflow coincides with the need for natural flows in the mainstem rivers, their tributaries, and San Francisco Bay. Increasing low salinity habitat at Roe Island, Chipps Island, and at Collinsville will benefit rearing native fishes dependent on this type of habitat.

COARSE SEDIMENT SUPPLY: Maintain a sustainable supply of natural sediments to the Delta. Sediments are one of the basic ecological components contributing to the development of the Delta landscape over the past 6,000 years. Sediments are needed to maintain floodplains, shallow shoals, mudflats, mid-channel islands, and contribute to maintaining and restoring riparian, wetland, and aquatic habitats. In the longer term, sediments may play an important role in reversing land subsidence on many Delta islands.

NATURAL FLOODPLAINS AND FLOOD PROCESSES: Expand the Delta floodplain by setting back or removing portions of the levee. This would enhance floodwater and sediment retention in the Delta and provide direct and indirect benefits to floodplain dependent fish and wildlife. Such floodplain expansion should also help alleviate flooding potential in other areas of the Delta.

CENTRAL VALLEY STREAM TEMPERATURES: During spring and fall, Delta channels are used by anadromous fish for migrating between rivers and the Pacific Ocean and are used as rearing areas as well. Untimely high water temperatures stress migrating fish by delaying their movement or causing mortality. Improvements in riparian and SRA habitat along Delta channels would improve water temperatures in small but important increments in these areas during critical fall and spring migrating periods. Higher inflow in late winter and early spring will help delay warming of the Delta channels.

DELTA CHANNEL HYDRAULICS: Confinement of Delta channels and use of channels to convey water across the Delta has led to reduced productivity and habitat value of Delta channels. Restoration of natural hydraulic conditions in some Delta channels would improve productivity and habitat values.

BAY-DELTA AQUATIC FOODWEB: The aquatic foodweb of the Delta, which supports important resident and anadromous fish, has been severely impaired. The major foodweb stressors include drought, reductions in freshwater flow, water diversions, introductions of non-native species (e.g., Asiatic clams), and loss of shallow water and wetland habitats. Proposed improvements in spring flows, channel hydraulics, wetland habitats, and floodplain inundation should lead to a healthier and more productive aquatic foodweb. Improved water quality and greater sediment retention in wetland, riparian,

and floodplain habitats will also increase foodweb productivity.

VISIONS FOR HABITATS

TIDAL PERENNIAL AQUATIC HABITAT: Land reclamation in the Delta has reduced the area of tidal aquatic habitats such as small sloughs, ponds, and embayments in tidal wetlands. Increased tidal wetland acreage and associated aquatic habitats will provide additional valuable fish and waterfowl habitats.

NONTIDAL PERENNIAL AQUATIC HABITAT: Increasing the area of ponds and lakes on leveed land in the Delta will provide needed habitats for shorebirds, waterfowl, and wildlife.

DELTA SLOUGHS: Increasing the number, length, and area of dead-end and open-end sloughs in the Delta will benefit native fishes, as well as waterfowl, wildlife, and neotropical songbirds.

MIDCHANNEL ISLANDS AND SHOALS: Channel islands in the Delta have associated remnant shallow-water, wetland, and riparian habitats that are valuable for fish and wildlife and sensitive plants. Maintaining and restoring these islands is important given the lack of such habitats and limited potential for creating new habitats within the Delta channels.

FRESH EMERGENT WETLAND HABITAT: Restoring tidal and nontidal marshes in the Delta will benefit foodweb productivity and water quality. It will also provide important habitat for fish, waterfowl, wildlife, and sensitive plant species and communities.

SEASONAL WETLAND HABITAT: Increased seasonal flooding of leveed lands and flood bypasses will provide important habitats for shorebirds, waterfowl, and raptors, particularly Swainson's hawk, native plants and wildlife and for the spawning, rearing, and migration of native fish species. Flooding and draining of seasonal wetlands also contributes to the aquatic and terrestrial foodwebs of the Delta and Bay.

RIPARIAN AND RIVERINE AQUATIC HABITAT: Restoring riparian ~~(waterside)~~ vegetation corridors along levees and associated SRA habitats will benefit many native fish and wildlife species dependent on this type of habitat.

INLAND DUNE SCRUB: Protecting remaining inland dune scrub habitat will protect special-status wildlife populations and special plant species.

PERENNIAL GRASSLANDS: Protecting and improving perennial grassland habitats will benefit special-status wildlife populations, special status plants, and help protect adjoining wetland habitats.

FRESHWATER FISH HABITAT: Freshwater fish habitats are an important component needed to ensure the sustainability of resident native and anadromous fish species. The Delta provides floodplain pool ephemeral water habitat, sloughs, oxbow lakes, and backwater habitats, valley floor rivers which include the main channels of the Sacramento and San Joaquin (Moyle and Ellison 1991). The quality of freshwater fish habitat in the Delta will be maintained through actions directed at streamflows, coarse sediment supply, stream meander, natural floodplain and flood processes, and maintaining and restoring riparian and riverine aquatic habitats and tidally influenced shallow water habitats.

ESSENTIAL FISH HABITAT: The Delta has been identified as Essential Fish Habitat (EFH) based on the definition of waters currently or historically accessible to salmon (National Marine Fisheries Service 1998). Key features of EFH to maintain or restore in the Delta include substrate composition; water quality; water quantity, depth and velocity; channel gradient and stability; food; cover and habitat complexity; space; access and passage; and flood plain and habitat connectivity.

AGRICULTURAL LANDS: Improving habitats on and adjacent to agricultural lands in the Delta will benefit native waterfowl and wildlife species. Emphasizing certain agricultural practices (e.g., winter flooding and harvesting methods that leave some grain in the fields) will also benefit special-status wildlife such as sandhill cranes.

VISIONS FOR REDUCING OR ELIMINATING STRESSORS

WATER DIVERSIONS: Screening, consolidating, reducing, and relocating water diversions will reduce loss of important fish and aquatic foodweb organisms. These actions will also improve Delta outflow and channel hydraulics. Relocating south Delta diversion